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ABSTRACT

The third of four guidebooks using UICSM's "stretcher and shrinker" approach, this booklet includes work with the four operations with fractions and mixed numbers, and problems with per cent. Goals for the course, general performance objectives, teaching suggestions, and a suggested time schedule are given. Objectives for each topic are specified. A bibliography of 16 references for enrichment and practice activities is included. For other booklets in this set, see SE 014 885 and SE 014 883. (DT)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE



DOUBLE-S FRACTIONS

5211.15
5212.15

MATHEMATICS

ED 067291

QUINMESTER MATHEMATICS

COURSE OF STUDY

FOR

DOUBLE-S FRACTIONS

5211.15

5212.15

(EXPERIMENTAL)

DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida 33132
1971-72

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PREFACE

The following course of study has been designed to set a minimum standard for student performance after exposure to the material described and to specify sources which can be the basis for the planning of daily activities by the teacher.

The course sequence is suggested as a guide; an individual teacher should feel free to rearrange the sequence whenever other alternatives seem more desirable. Since the course content represents a minimum, a teacher should feel free to add to the content specified.

Any comments and/or suggestions which will help to improve the existing curriculum will be appreciated. Please direct your remarks to the Consultant for Mathematics.

All courses of study have been edited by a subcommittee of the Mathematics Advisory Committee.

CATALOGUE DESCRIPTION

The third of four quins designed to develop computational skills with fractions, percents, and decimals using the "stretcher and shrinker" approach developed by the University of Illinois Committee on School Mathematics. Includes the four operations with fractions and mixed numbers, and works with percent.

Designed for the student who has successfully completed Double-S Number Theory, 5211.09/5212.09.

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GOALS

1. To introduce the student to the stretcher-shrinker model of fractions
2. To give the student positive success-oriented experiences in math and increase his motivation
3. To develop and increase the student's understanding of, and skill with, basic operations with fractions and percent
4. To increase the student's communication skills with computational concepts

PERFORMANCE OBJECTIVES

The student will (with multiplication tables provided when desired)--

1. Define any given fraction as the product of the numerator and the reciprocal of the denominator; i.e.:

$$\frac{a}{b} = a \times \frac{1}{b}$$

2. Indicate the fractional part(s) shown by an object, a set of objects, or a pictorial representation.
3. Find the sum of:
 - a. any two fractions
 - b. any two mixed numbers
 - c. any whole number and any mixed number
 - d. any whole number and any fraction
 - e. any fraction and any mixed number

where the fractional parts have the same or unlike denominator.

4. Find the difference of

- a. any two fractions
- b. any two mixed numbers
- c. any whole number and any mixed number
- d. any whole number and any fraction
- e. any fraction and any mixed number

where the fractional parts have the same or unlike denominator.

5. Determine the mixed number equivalent to a given improper fraction.

6. Determine the improper fraction equivalent to a given mixed number.

7. Find the product of

- a. any two fractions
- b. any two mixed numbers
- c. any whole number and any mixed number
- d. any whole number and any fraction
- e. any fraction and any mixed number

where the fractional parts may have unlike denominators.

8. Find the quotient of

- a. any two fractions
- b. any two mixed numbers
- c. any whole number and any mixed number
- d. any whole number and any fraction
- e. any fraction and any mixed number

where the fractional parts may have unlike denominators.

9. Solve selected word problems involving fractions and mixed numbers.

10. Given a percent (fraction), express it as a fraction (percent).
11. Solve simple problems involving percent.
12. Indicate his appreciation of the role of mathematics in today's complex society by selecting from newspapers and periodicals examples showing the use of fractions.
13. Use equals, less than, or greater than to compare any two fractions.

STRATEGIES

Before beginning this quin, the teacher should read carefully the course description and comments contained in the Teacher's Edition and the Activities Handbook. In addition to these, the following general comments apply:

- (1) Entering competencies required are: mastery of Double-S Number Theory 5211.09/5212.09.
- (2) In order to maintain student interest it is recommended that the teacher stick closely to the story line. A machine either stretches or shrinks, not multiplies or divides. The kids will realize the multiplier and divider properties of the machines and will verbalize this. You should acknowledge the correctness of this and then go on using machine terminology. One of the major benefits of this course is its novelty, don't destroy it.
- (3) The heart of the course is found in the hundreds of activities found in the Activities Handbook, activities which foreshadow, expand, drill and supplement the development found in the text. The frequent and short quizzes found in that handbook help students to gain confidence, while at the same time reviewing small blocks of pages.
- (4) It is practically impossible to use all the activities in the handbook. The activities are divided into required and optional. Plan to use all the required activities and those optional activities that are appropriate to your class and the time available.
- (5) It is recommended that the overhead projector be used extensively. Many of the activities utilize transparencies, and transparencies of important workbook pages should be made to assist with discussion. Transparencies of quizzes and tests are valuable so that students can either grade each other's paper or immediate feedback and discussion opportunities can be provided.
- (6) The work text should be used primarily in a class-discussion approach, hopefully utilizing the overhead projector. Too much can be lost by simply working pages. The important ideas should be expanded and emphasized.

- (7) Discretion should be used in deciding whether or not to allow books to go home. It has been found effective to have row leaders distribute and collect books each day, leaving the books in the room. A beginning activity on the board can be used to expand on and review the material and to settle the students while the row leaders are distributing the books.
- (8) The course was designed to be used in a work text type program. Much thought and planning should occur before utilizing the text as nonconsumable materials.
- (9) Classroom supplies: Stretchers and Shrinkers

Assuming a class size of 30, the following supplies would be consumed by the class in one year. (4 quins: 5211.08/5212.08-5211.20/5212.20.)

- 30 - student sets (Book 1-4) of Stretchers and Shrinkers (if used consumably)
- 200 - index cards (3x5)
- 10 - reams of duplicator paper

The materials which follow may be used with several classes and should be saved from year to year:

- 1 - Teacher's Edition of Stretchers and Shrinkers
- 1 - Activities Handbook for Stretchers and Shrinkers
- 1 - meter stick
- 1 - yard stick
- 1 - box colored chalk
- 2 - boxes (100 sheets/box) thermal spirit masters
- 2 - boxes (100 sheets/box) transparency film for overhead projector
- 30 - scissors
- 30 - rulers (marked in inches and centimeters)
- 200 - file folders

You will also require the daily use of an overhead projector (with colored pens) and a file cabinet (at least three drawers).

STRETCHERS AND SHRINKERS

Time Schedule

Fractions

<u>Chapter 1</u>				
1-21	Percent			8 days
	2 Quizzes			
<u>Chapter 2</u>				
22-60	Fraction Machines			9 days
	3 Quizzes	Test		
<u>Chapter 3</u>				
61-86	Multiplying by a Fraction			6 days
	2 Quizzes			
<u>Chapter 4</u>				
87-107	Dividing by a Fraction			6 days
	2 Quizzes			
<u>Chapter 5</u>				
108-136	Adding and Subtracting Fractions			9 days
	2 Quizzes			
<u>Chapter 6</u>				
137-154	Mixed Numbers			5 days
<u>Chapter 7</u>				
155-160	Percent Revisited			
	1 Quiz	Test		2 days

45

If you finish early or feel the need to supplement any area, use the recommendations in the appendix for enrichment activities and/or computational review.

BOOK 3, CHAPTER 1: PERCENT

TEXT PAGES	TOPIC	OBJECTIVE
1-3	Using the 100-machine in a hookup	<p>a. Given a job with input and output lengths, the student can design a hookup with a 100-machine to do the job.</p> <p>b. Given an input and a hookup with a 100-machine, the student can compute the output.</p>
4-8	Introducing and using percent hookups	Same objectives as for pp. 1-3, using % notation.
9	Writing routing slips with percent hookups	Same objectives as for pp. 1-3, using routing slip format.
10-15	Solving equations and word problems involving percents	Given a word problem involving percents, the student is able to solve the problem using the linguistic form ____ % of ____.
16-17	Determining whether a percent hookup stretches, shrinks, or does a no-change job.	Given a percent hookup the student is able to tell whether it stretches, shrinks, or does a no-change job.
18-19	Computing inputs to percent hookups	Given a percent hookup and the output, the student can supply the input.



(BOOK 3, CHAPTER 1: PERCENT)

TEXT PAGES	TOPIC	OBJECTIVE
20-21	Finding best approximations for percent hookups to do cannot-do jobs	Given a cannot-do job involving a percent hookup, the student can supply the other machine in the hookup, i.e., the best approximation.

BOOK 3, CHAPTER 2: FRACTION MACHINES

TEXT PAGES	TOPIC	OBJECTIVE
22-24	Introducing fraction machines, notation, and related vocabulary	Introductory.
25-31	Establishing the relationship between fractions and short mixed hook-ups	<ol style="list-style-type: none"> Given a short mixed hookup, the student can give a fraction machine that does the same job. Given a fraction machine, the student can give a short mixed hookup to do the same job. Given a fraction, the student can identify the numerator (stretcher) and the denominator (shrinker).
32-39	Finding outputs	<ol style="list-style-type: none"> Given an input length and a fraction machine, the student is able to give the output length. Given a job specified by input and output lengths, the student can tell a fraction machine to do the job.
40-41	Stretching, shrinking, and no-change fraction machines	Given a fraction machine, the student can tell whether it stretches, shrinks, or is a no-change machine.

(BOOK 3, CHAPTER 2: FRACTION MACHINES)

TEXT PAGES	TOPIC	OBJECTIVE
42-43	Figuring out the input given the output and machine	Given a fraction machine and output length, the student is able to compute the input.
44-45	Using history cards, and solving equations	Objectives the same as for pp. 32-39 and 42-43, except information is given in history card equation formats.
46-51	Using conventional terminology and magnitudes other than length	<p>Objectives similar to those for pp. 32-39 and 42-43 except problems are stated in the conventional language:</p> <div style="text-align: center;">  </div> <p>where  is the fraction being considered.</p> <p>Given any two of input, machine, and output, the student is able to find the third. Given the information in story form, the student is able to identify the information and translate it into an equation and solve it.</p>
52-53	Finding equivalent fractions in lowest terms by removing inverse	Given a fraction not in lowest terms the student can factor the numerator and denominator to identify hidden inverses, remove them, and give an equivalent fraction in lowest terms.

(BOOK 3, CHAPTER 2: FRACTION MACHINES)

TEXT PAGES	TOPIC	OBJECTIVE
54-56	Inserting pairs of inverses in fractions	Given a fraction, the student can, by inserting pairs of inverses, give an equivalent fraction.
57	Stuck dials and cannot-do jobs	Given a fraction, and a machine with a stuck denominator dial, the student can tell whether or not the numerator dial can be set to do the fraction job.
58-60	Reducing fractions to lowest terms	Given a fraction with hidden inverses, the student can reduce the fraction to lowest terms.

BOOK 3, CHAPTER 3: MULTIPLYING BY A FRACTION

TEXT PAGES	TOPIC	OBJECTIVE
61-69	Simplifying hookups with fractions to single fractions in lowest terms	Given a hookup of fraction machines or of a fraction machine with a stretcher, the student can give a single fraction machine in lowest terms to compute outputs using both hookup notation and conventional notation.
70-72	Defining fractional lengths	Given a fraction machine and a unit input length, the student is able to tell the fractional output length.
73-74	Comparing fractional lengths	Given fractional lengths, the student can order them according to size.
75-80	Replacing "fractional inputs through fraction machine jobs" with equivalent "unit inputs through fraction machine hookup jobs"	Given a fractional length input and fraction machine, the student can tell which unit input and fraction machine hookup will do the same job and compute the final output length.
81-86	Multiplying by a fraction	The student is able to calculate the product of a fraction and a whole number, or two fractions.

BOOK 3, CHAPTER 4: DIVIDING BY A FRACTION

TEXT PAGES	TOPIC	OBJECTIVE
87-91	Putting sticks through machines backward as well as forward	<ul style="list-style-type: none">a. Given a machine and a length, the student is able to tell the resulting length when the machine is run forward or backward.b. Given a job, the student can tell which machine to use forward or backward to do the job.
92-97	Using new and old history cards to indicate whether the forward or backward mode is to be used to compute output lengths	<ul style="list-style-type: none">a. Given a single machine or a hookup and an input length, the student can write a history card, giving the proper mode (forward or backward), and tell the result.b. Given a history card the student can build the single machine or hookup, tell the correct mode, and give the final output length.
98-101	Changing backward mode jobs to equivalent forward mode jobs	Given a backward mode job, the student can translate it into an equivalent forward mode job, and compute the output.

(BOOK 3, CHAPTER 4: DIVIDING BY A FRACTION)

TEXT PAGES	TOPIC	OBJECTIVE
102-107	Replacing a fraction divisor by its inverse multiplier	<ol style="list-style-type: none">Given a fraction, the student can give its inverse.Given a "dividing by a fraction problem," the student is able to replace it with an equivalent "multiplying by a fraction problem," and compute the result.

BOOK 3, CHAPTER 5: ADDING AND SUBTRACTING FRACTIONS

TEXT PAGES	TOPIC	OBJECTIVE
108-110	Making longer sticks from shorter ones by drawing	Introductory.
111	Introducing gluing	
112-113	Computing output or input lengths made by either stretching, shrinking, or gluing	Given a history card for stretching, shrinking, or gluing, the student is able to compute the output.
114-116	Introducing sawing and solving equations	Given a history card for stretching, gluing, or sawing, the student can compute the output. (No sawing or gluing of fractional lengths.)
117	A quick review	
118-120	Addition of fractions	Introductory.
122-134	Computing sums and differences of whole number and fractional lengths	a. Given fractional or whole number lengths, the student is able to add or subtract them.
	Using shortcuts to add and subtract fractions	b. Given fractional or whole number lengths, the student can, when possible, use shortcuts to add or subtract them.

(BOOK 3, CHAPTER 5: ADDING AND SUBTRACTING FRACTIONS)

TEXT PAGES	TOPIC	OBJECTIVE
135-136	Using addition or subtraction of fractions to solve problems	Given a story problem, the student can set up an addition or subtraction of fractions equation and solve it.

BOOK 3, CHAPTER 6: MIXED NUMBERS

TEXT PAGES	TOPIC	OBJECTIVE
137-141	Using mixed numbers to label sticks	<p>a. Given a fraction (for a number greater than 1), the student can convert to an equivalent mixed number.</p> <p>b. Given a mixed number, the student is able to convert to an equivalent fraction.</p>
142-147	Adding and subtracting	Given lengths expressed in whole, fractional, or mixed number form, the student is able to give their sum or difference.
148-150	Multiplying and dividing mixed numbers	Same objective as for pp. 142-147, but for products and quotients.
151-154	Using mixed numbers to solve problems	Given a story problem, the student identifies the important data in mixed number notation and computes a sum or difference to solve the problem.

BOOK 3, CHAPTER 7: PERCENT REVISITED

TEXT PAGES	TOPIC	OBJECTIVE
155-158	Converting mixed-number percents to fractions and solving problems with mixed-number percents	<ul style="list-style-type: none">a. Given a percent in mixed-number notation, the student can convert it to an equivalent fraction.b. Given a story problem involving mixed number percents, the student is able to identify the important data, and solve the problem.
1959-1960	Summary of Book 3	<ul style="list-style-type: none">a. Given a fraction (mixed hookup), the student is able to give an equivalent mixed hookup (fraction).b. Given an addition, subtraction, multiplication, or division problem involving fractions, the student is able to solve it.c. Given a pair of fractions, the student can tell whether they are equivalent or which is the larger (smaller) number.d. Given a percent (fraction), the student can express it as a fraction (percent).e. Given a problem dealing with percents, the student is able to solve it.

PRETEST

The posttest for 5211.09/5212.09 should serve as the pretest for this quin.

POSTTEST

Utilize Activity 195 (Test 5) and Activity 220 (Test 6) in the Activities Handbook as the posttest for this quin.

Suggested Sources of Enrichment and Practice Activities

A. State adopted

1. Crouch, William H. Coordinated Cross Number Puzzles A, B, C. New York: McCormick-Mathers Publishing Co., 1970.
2. Denholm, R. A. and Blank, V. D. Mathematics Structure and Skills 1st Book. Chicago: Science Research Associates, 1968.
3. Foley, Jack; Jacobs, Wayne and Basten, Elizabeth. Individualizing Mathematics. Menlo Park, California: Addison Wesley Publishing Co., 1970.

Skills and Patterns

Whole Numbers

Numbers-Patterns-Theory

Sets

Fractions--Addition and Subtraction

Fractions--Multiplication and Division

Decimals--Meanings and Operations

4. Johnson, D. A., et al. Activities in Mathematics: First Course: Number-Patterns. Glenview, Illinois: Scott, Foresman and Co., 1971.
5. Sobel, Max A., et al. Essentials of Mathematics Series: Book 1. Boston: Ginn and Company, 1970.

6. Tucker and Wheeler. Mathematics Laboratory. New York: McCormick-Mathers Publishing Co., 1970.

7. Wirtz, Robert W., et al. Math Workshop Levels C, D, E. Chicago: Encyclopedia Britannica Educational Corp., 1964.

B. Non-state adopted

1. Brandes, Louis G. Yes, Math Can Be Fun. Portland, Maine: J. Weston Walch, 1960.

2. Dumas, Enoch. Arithmetic Games. Palo Alto, California: Fearon Publishers, Inc., 1960.

3. _____. A Collection of Cross Number Puzzles.

4. Larsen, Harold. Games to Play.

5. _____. Guzintas.

6. _____. Ways to Multiply.

7. _____. Brain Teasers.

Evanston, Illinois: Harper and Row, Publishers, 1961.

8. Meyer, Jerome S. "Arithmetricks." Englewood Cliffs, N. J.: Scholastic Magazine, 1965.

9. Wagner, Guy, et al. Arithmetic Games and Activity. Darien, Connecticut, 1964.